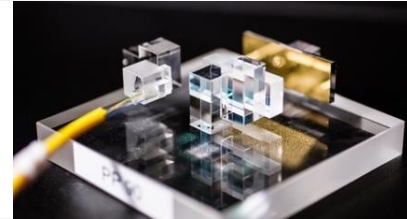


# Turbulence mitigated single-mode fiber output based on Multi-Plane Light Conversion technology with all-optical coherent recombiner

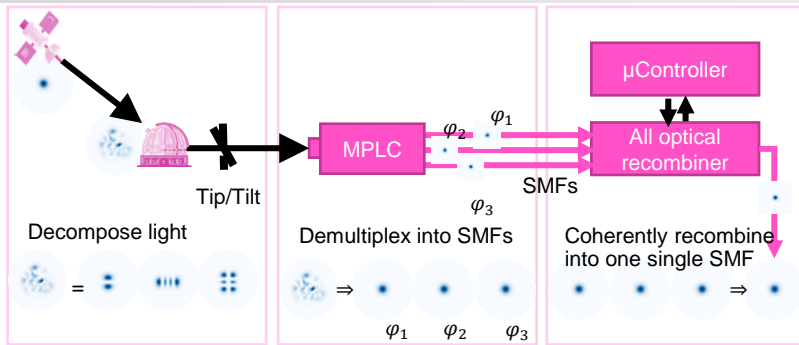
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## Motivation

Compensating atmospheric turbulence is of prime importance to deploy high-speed laser communication network. Beside classical adaptive optics compensation scheme, **spatial division multiplexing** approach based on **Multi-Plane Light Conversion (MPLC)** proves to be an efficient, scalable, and easy to implement solution to mitigate turbulence.



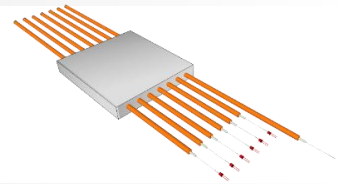
## Turbulence mitigation scheme



Our approach relies on **spatial mode demultiplexing with an MPLC**. The technique enables to couple light into multiple single mode fibers. However, due to the multiple SMF outputs, performing a telecommunication link requires complex numerical post-processing to rephase the signals from SMFs. To overcome this issue, we developed an all optical recombing.

## All optical recombing

8 SMF with polarization maintaining are combined in a cascaded manner into a unique PM-SMF output. Using Mach-Zehnder (MZ) interferometers, we balance the different inputs in **amplitude** and **phase lock** the different channels.



## Fabrication and results

We fabricated a first prototype with fibered MZ and a second version on a photonic integrated chip (PIC).

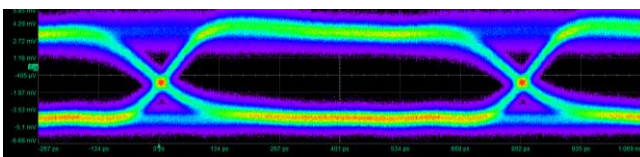
### Fiber based version

- 8 to 1 recombining
- $> 4\pi$  phase shift
- $> \text{kHz}$  modulation
- Tested with 1,25 Gbaud recombining
- But High IL



### PIC version

- 8 to 1 recombining
- Up to  $6\pi$  phase shift
- $> \text{kHz}$  modulation
- Insertion loss on table below



	Chip 1		Chip 2		Chip 3	
	Ch 1	Ch 2	Ch 1	Ch 2	Ch 1	Ch 2
IL (dB)	1,8	1,7	2,3	1,6	2,0	1,6